The AILEG PROJECT

MEMORANDUM

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FROM: Rodolfo Camacho, Michèle Laird, and Santiago Enriquez (Abt Associates Inc.)
DATE: February 13, 2012
RE: AILEG Colombia Needs Assessment—Trip Report
CONTRACT N0. EEM-I-00-07-00004-00
TASK ORDER: AID-OAA-TO-11-00041

Abt Associates conducted a country visit for the USAID Analysis and Investment for Low-Emission Growth (AILEG) Project to ascertain the critical technical assistance needs of the Government of Colombia (GOC), the private sector, and civil society to support the Enhancing Capacity in Low-Emission Development Strategies (EC-LEDS) strategic partnership between the GOC and the United States government. This document summarizes the findings of the country visit and presents recommendations for AILEG technical support to EC-LEDS Colombia.

ACRONYMS

A1B	Balance across all sources scenario
A1FI	Fossil-intensive
AILEG	Analysis and Investment for Low-Emission Growth
A1T	Non-fossil energy sources scenario
BAU	Business-as-usual
BOT	Build-operate-transfer
CAM	Corporación Autónoma Regional del Alto Magdalena/Regional Autonomous Corporation of the Upper Magdalena
CARs	Corporaciones Autonomas Regionales/Autonomous Regional Corporations
CCEP	Colombia Clean Energy Program
CDM	Clean Development Mechanism
CGE	Computable General Equilibrium
DCA	Development Credit Authority
DNP	Departamento Nacional de Planeación/National Planning Department
ECDBC	Estrategia Colombiana de Desarrollo Bajo en Carbono/Colombian Low-Carbon Development Strategy
EC-LEDS	Enhancing Capacity in Low-Emission Development Strategies
FAZNI	Fondo de Apoyo Financiero para la Energización de las ZNI/ Financial Support Fund for the Electrification of the ZNIs
FCMC	Forest, Carbon, Markets and Climate project
FNR	Fondo Nacional de Regalias/National Royalty Fund
GDP	Gross domestic product
GHG	Greenhouse gas
GIS	Geographic information system
GOC	Government of Colombia
IPSE	Instituto de Planificación y Promoción de Soluciones Energeticas para las Zonas No Interconectadas/Institute of Planning and Promotion of Energy Solutions in the Non-Interconnected Zones
LEDS	Low-emission development strategies
MAC	Marginal abatement cost
MADS	Ministerio de Ambiente y Desarrollo Sostenible/Ministry of Environment and Sustainable Development

MAPS	Mitigation Action Plans & Scenarios
MME	Ministerio de Minas y Energía/Ministry of Mines and Energy
NAMA	Nationally Appropriate Mitigation Actions
PES	Payment for Environmental Services
PROURE	Programa de Uso Racional y Eficiente de la Energía y demás Formas de Energía no Convencionales/Program of Rational and Efficient Use of Energy and Other Forms of Non-Conventional Energy
REDD	Reducing Emissions from Deforestation and Forest Degradation
UCLA	University of California at Lost Angeles
UPME	Unidad de Planeación Minero Energética/Mines and Energy Planning Unit
USAID	United States Agency for International Development
ZNI	*Zonas No Interconectadas*

SUMMARY

The Analysis and Investment for Low-Emission Growth (AILEG) Project helps governments, USAID missions, and other stakeholders to integrate climate change economics and investment into low-emission development strategies (LEDS). AILEG tailors support to each country's unique capacity; data availability; and technical, analytical, and policy needs. The project helps countries integrate assessment models and tools across a range of interrelated climate economic and investment areas. While responding to heterogeneous demands and data availability, AILEG assists through technical assessments and evaluations, data improvement and management, capacity building, and training and knowledge dissemination.

The Government of Colombia (GOC) and USAID/Colombia have expressed the desire for AILEG to help develop a work plan for technical assistance in several key areas—marginal abatement cost (MAC) curves for the residential housing sector, Nationally Appropriate Mitigation Actions (NAMAs) for clean energy services options in the country's off-grid areas, resource valuation and Payment for Environmental Services (PES) support, and economic and investment assessment of Colombia LEDS analyses. The goal of this assignment was to conduct a country scoping mission to determine the current status of and needs for support in these work areas in Colombia and to outline the steps AILEG will take to provide such support.

The AILEG team of Rodolfo Camacho (Project Quality Advisor), Michèle Laird (Team Leader), and Santiago Enriquez (Climate Change Expert) visited Bogota, Colombia, the week of January 29–February 6, 2012, to meet with USAID/Colombia, MADS [the Ministerio de Ambiente y Desarrollo Sostenible/Ministry of Environment and Sustainable Development], DNP [the Departamento Nacional de Planeación/National Planning Department], IPSE [the Instituto de Planificación y Promoción de Soluciones Energeticas para las Zonas No Interconectadas/Institute of Planning and Promotion of Energy Solutions in the Non-Interconnected Zones], local universities and consultants working in the climate change areas identified as needing technical assistance, other stakeholders, and potential partners. The Annex contains a list of meetings and contacts.

As a result of the meetings held and information shared, the AILEG Colombia Assessment team has 1) explored the need for assistance in the four areas mentioned above; 2) assessed AILEG's potential role in these areas; 3) identified other areas in which there is demand for assistance that falls under AILEG's scope; and 4) proposed potential areas in which AILEG can provide support to Colombia to integrate climate change economics and investment into LEDS. The following sections of the report describe the findings of the assessment mission and the proposed timeline for AILEG assistance.

In summary, the team is proposing that the AILEG project provide assistance in the following areas:

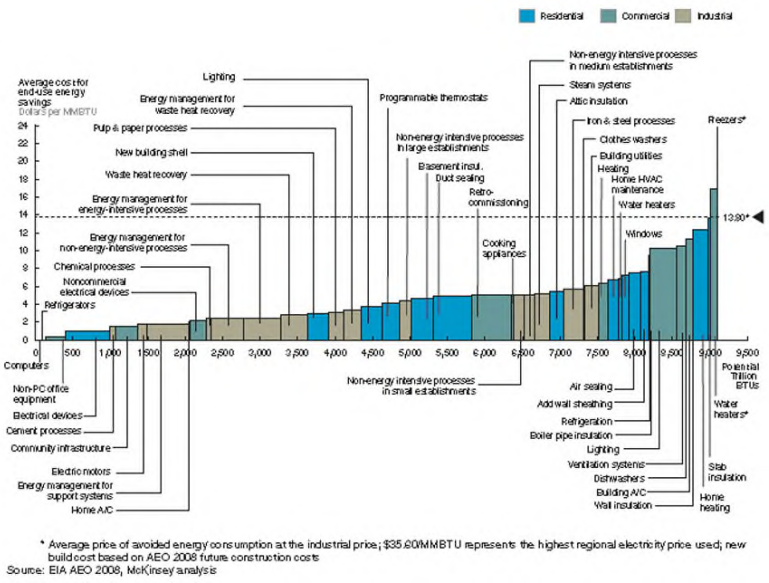
1. develop a MAC curve for the institutional and commercial building sector
2. support the development of economic valuation studies for priority ecosystems in Colombia, through training and study tours
3. support the development of an online registry of PES schemes, as required by MADS
4. provide technical assistance for coupling the Computable General Equilibrium (CGE) model with sector models once the sector modeling is finalized
5. provide assistance to develop and apply a partial equilibrium model to assess the impacts of climate change on agriculture
6. develop and apply two models for the upper Magdalena River Basin: 1) a land-use/hydrology/energy-generation PES model and 2 a land-use/partial equilibrium model

Next steps include vetting the proposed areas of assistance with USAID, analyzing the needs in each area in more depth, developing a detailed work plan and budget, and proposing technical teams for the activities. A revised timeline will be submitted with the work plan.

FINDINGS AND PROPOSED TECHNICAL ASSISTANCE

Marginal Abatement Cost Curves for the Residential Housing Sector

MAC curves are one among several bottom-up[1] economic assessment frameworks to determine the potential financial and environmental co-benefits[2] from the adoption of greenhouse gas (GHG) emissions mitigation actions. MAC curves are beginning to gain traction as a financial tool to compare the merits of competing carbon reduction projects and technologies. A marginal abatement cost itself is the cost of a particular low-carbon technology. *Abatement* means that the project lowers a country's or business's carbon footprint rather than increasing it, while *marginal* refers to the cost per unit produced (or in this case, per unit of carbon saved). MAC curves are variable-width histograms that plot the marginal abatement cost, projecting net present value per ton of carbon against the amount of carbon saved, with data sorted by ascending MAC value. More concisely, MAC curves enable a visual comparison between different projects, looking at the cost to implement them and the amount of carbon they can save. MAC curves are also useful for determining what the price of carbon needs to be for a project or action to become more financially viable than inaction, and what combination of projects needs to be employed to reach a specific carbon reduction goal. As a result, MAC curves help governments or other institutions to make informed decisions on how to best meet their carbon reduction targets or obligations.



* Average price of avoided energy consumption at the industrial price; $35.60/MMBTU represents the highest regional electricity price used; new build cost based on AEO 2008 future construction costs

Source: EIA AEO 2008, McKinsey analysis

Because the residential building sector is important in driving Colombia's GHG emissions from households, there is a need to enhance past estimates of GHG emissions mitigation actions costs and benefits. As part of the assessment of potential AILEG activities in Colombia, the Abt team assessed the work to date in Colombia on the development of estimates of marginal abatement costs for GHG emissions reduction options in the residential building sector. The team met with stakeholders to see which additional tasks and assistance are needed to complete estimates.

[1] A bottom-up approach begins with details and works up to the highest conceptual level; in economic forecasting it can mean starting with individual sectors and working up to a macro-economic analysis or beginning at the regional level and working up to a national one.
[2] As defined in the U.S. Environmental Protection Agency's "Glossary of Climate Change Terms," co-benefits are benefits of policies that are implemented for various reasons at the same time—including climate change mitigation—acknowledging that most policies designed to address greenhouse gas mitigation also have other, often at least equally important, rationales (e.g., those related to objectives of development, sustainability, and equity).

1. Status/Needs

Although the scope of work for the AILEG Colombia Assessment identified the development of a MAC curve for the residential housing sector as a potential need, there is already a current project to calculate CO_2 emission levels and develop a MAC curve for urban housing. It is an initiative of MADS and the Colombian Green Building Council (Consejo de Construcción Sostenible), implemented by the University of Los Andes with British government funding. The project will deliver MAC curves for the building sector in Colombia, starting with the housing sector in three main cities (Bogota, Medellin, and Barranquilla) that represent three major climates in Colombia. The University of Los Andes Study is performing a diagnostic of the housing sector for three housing typology groups: 1) old and new, 2) single and multi-family, and 3) subsidized and non-subsidized. The university will also apply the Home Energy Efficient Design model developed by the University of California at Lost Angeles (UCLA) to examine potential reductions in energy, CO_2 emissions, and savings from changes in design and retrofits. This MAC curve is expected to be an important input for an ongoing project within MADS. This project, known as ECDBC [the Estrategia Colombiana de Desarrollo Bajo en Carbono/Colombian Low-Carbon Development Strategy] is a priority in the National Development Plan 2010–2014.

Meanwhile, there remains a gap in sectoral analysis—MAC curves for the institutional and commercial construction sectors. Originally, this was to be done as part of a larger housing/construction scope of work developed by MADS. However, because funding from the British government was not sufficient to cover all of the tasks, the scope for that project was reduced to the residential housing sector. MADS is interested in having AILEG support the development of MAC curves for the institutional and commercial sectors, since the cost of developing these estimates is not covered by British assistance.

2. Recommended Technical Assistance

The AILEG team proposes to develop MAC curves for the institutional and commercial sectors, working in coordination with MADS and the Green Building Council. The AILEG team will also coordinate with the University of Los Andes' study of the residential housing sector in the priority cities covered under that study.

Nationally Appropriate Mitigation Actions for Clean Energy Services Options in the Power Company's Off-Grid Areas

The expansion of energy in off-grid areas of Colombia is essential to increase rural development and national productivity. The national power company, IPSE, is responsible for selecting, investing in, and implementing most off-grid power production and energy services operations throughout the country. A critical path forward for the country on LEDS is to identify and implement cost-effective clean energy (e.g., renewable, efficient energy) in rural areas where grid extension is cost-prohibitive and geographically prohibitive. As part of the assessment of potential AILEG activities in Colombia, the team reviewed the status of IPSE's off-grid clean energy development efforts and interviewed IPSE staff and others about needs and options for assistance.

1. Status/Needs

Colombia's challenge is to advance grid and off-grid energy programs and energy efficiency in the context of pursuing low GHG-emitting economic growth. Colombia has a sophisticated energy system with significant private sector investment, which has resulted in advanced project experience and capacity in both private sector institutions (such as utilities and universities) and public sector institutions (e.g., MME [the Ministerio de Minas y Energía/Ministry of Mines and Energy], UPME [the Unidad de Planeación Minero Energética/Mines and Energy Planning Unit]). IPSE is charged with providing affordable, reliable energy to off-grid regions in Colombia (known in Spanish as *Zonas No*

Interconectadas, or ZNIs). The ZNIs represent 66 percent of the national territory: 17 departments, five departmental capitals, 54 municipalities, 1,262 localities, 94 energy service providers, and 159 megawatts installed. Colombia's population is approximately 49 million. There are currently 2.5 million Colombians who are off-grid; of these, 1.2 million are the responsibility of UPME and 1.3 million are the responsibility of IPSE. Of the 1.3 million under IPSE's charge, approximately 750,000 have energy service and approximately 520,000 do not. Almost all of the ZNIs with service receive their energy through diesel.

One of the goals prioritized in the country's National Development Plan 2010–2014 is for the average daily time of energy service to municipal capitals (*cabeceras*) in the ZNIs to increase from 16 hours to 24 hours.

The ZNIs of Colombia, covering two-thirds of the country's territory, are distributed principally in large regions of the Pacific Coast, the Orinoquia, the Amazon, the high Guajira, and the Archipelago of San Andres and Providencia. The areas are characterized not only by great biological, landscape, ethnic, and cultural diversity but also by geographic isolation, poor land management planning and regional development programs, marginalization of the people, social conflicts, and fragile existing ecosystems.

With 159 megawatts installed in the ZNIs, more than 90 percent of the zones' energy needs are covered by diesel plants. The thermal generation plants present diverse technical, environmental, and social problems. The problems lie principally in the following areas: 1) the low efficiency of the equipment; 2) difficult access to the zones for maintenance of the equipment and delivery of the fuel; 3) the high cost of energy generation; and 4) high risks to both the environment and the community from transport, storage, and use of fuel. In addition, there are environmental impacts from emissions, toxic effluents, noise, generation of residual solids, and management of chemical

substances. Due to these problems, strategies are needed for total or partial substitution of diesel as a source of energy.

Currently the financing for these zones corresponds to the FNR [Fondo Nacional de Regalias/National Royalty Fund] and the FAZNI [Fondo de Apoyo Financiero para la Energización de las ZNI/Financial Support Fund for the Electrification of the ZNIs]. These financing approaches anticipate a series of projects that may provide solutions for some localities in the zones, but will not address all of their needs. For this reason, it is important to search for additional resources to address the ZNIs' energy needs.

Various energy solutions have been evaluated. Interconnection has been prioritized over other options in areas where it would be easy to connect with regional networks to guarantee more efficient and reliable service with regulated tariffs that could be paid for by the community. To finance new connections or solutions, MADS and IPSE are interested in exploring the technical, institutional, and financial requirements and looking at the feasibility of additional Clean Development Mechanism (CDM) projects or NAMAs.

Meanwhile, the Colombia Clean Energy Program (CCEP), USAID/Colombia's flagship clean energy activity, has recently begun. USAID's entry into the energy sector in Colombia is rooted in U.S. government policy related to climate change mitigation, adaptation, and biodiversity conservation.

CCEP will be implemented by Tetratech/ARD by 1) utilizing the substantial legal and regulatory framework already in place to advance renewable energy and efficiency objectives, 2) creating dedicated project delivery teams and organizations under each task, and 3) strengthening federal, state, and local organizations' ability to absorb the new tools and methodologies (such as LEDS) provided by the implementer.

The CCEP scope of work is structured around the following three tasks:

1. **Renewable energy and energy efficiency.** The CCEP implementer will work closely with MME, UPME, and IPSE to meet renewable energy targets and to implement renewable energy programs in the ZNIs. The implementer will also support the Energy Efficiency Implementation Division of the MME (where appropriate and in support of USAID/Colombia's LEDS goals), which will drive programs across utilities and end-users. This may include integrating ongoing MME efforts, identifying pilot projects, and providing capacity building in all technical areas, particularly in the monitoring of the 2015 savings goals and LEDS processes of PROURE [the Programa de Uso Racional y Eficiente de la Energía y demás Formas de Energía no Convencionales/Program of Rational and Efficient Use of Energy and Other Forms of Non-Conventional Energy].
2. **Expansion of access to renewable energy sources**. The project implementer will focus on building the technical strength of IPSE, other local agencies, and NGOs, laying a firm foundation for implementing concession models[3] for delivering investment in ZNI areas. As appropriate, the

[3] Concessions and leases are used to deliver certain public services, such as water and sometimes energy. The generic term is "delegated management," which applies to a contract concluded for the delivery of a public service, where the remuneration of the delegatee is largely dependent on operating results, and where management of the service is entrusted to a legal entity that can be a private company, individual, local semi-public company, association, another local authority or a public corporation not controlled by the delegating local authority. A Build-Operate-Transfer (BOT) is a type of concession. Others include operating concessions or even management contracts.

project will support entry points through the entire renewable energy project cycle: resource assessments and mapping, geographic information system (GIS) tools for project identification, cost analysis, and transaction and financing support. The project implementer will identify candidate pilot projects and will promote and facilitate community support for projects through outreach and education. Participatory approaches will be deployed to support productive energy use by rural communities.

3. **Energy efficiency and renewable energy investment promotion**. Related to Task 1, the project implementer will develop renewable energy and energy efficiency development plans with IPSE and MME. These plans will serve as a road map for promoting investment. They will include grants and training activities, as well as financial support and facilitation with local and international banks and USAID's Development Credit Authority (DCA) program.

CCEP project activities will be closely coordinated with other USAID/Colombia activities and with other bilateral and multilateral donor programs that support new national policies related to access to finance, assist conflict-affected populations through improved provision of public services, and help shape environmental policy.

According to the project's scope of work, specific actions under each CCEP component could include:

- Promoting rural electrification and renewable energy applications through technical assistance to banks, NGOs, and cooperatives to expand financial networks and introduce new services that meet the needs of vulnerable populations and small farmers in rural areas.
- Strengthening the GOC's capacity to design, adopt, and implement public policies related to renewable energy applications that improve the provision of public services and promote sustainable income generation to poor and vulnerable groups.
- Supporting the climate change and GHG emissions reduction policy and the national ECDBC by promoting renewable energy efficiency policies and tools such as NAMAs.

It is clear that IPSE will benefit from donor-financed technical assistance to meet its national plan goals. Assistance might include studies/diagnostics of ZNIs' energy needs and possible solutions, efforts to strengthen renewable energy regulation, assessments of clean energy pilot projects, programs on accessing finance for clean energy solutions, and support for improved monitoring. It is also evident that CCEP has the mandate, and the implementer has the capability, to assist IPSE in all of these areas.

2. Recommended Technical Assistance

As is discussed above, USAID's CCEP seems well-positioned to provide technical advisory and implementation support to IPSE and other Colombian energy partners and stakeholders to identify and implement cost-effective clean energy solutions in rural areas where grid extension is cost-prohibitive. At this time, the Abt team recommends that AILEG *not* pursue an activity in this area, as it is likely there would be significant overlap with CCEP's scope of work and program implementation.

Resource Valuation and Payment for Environmental Services Support

Traditional assessment of the financial costs of clean energy and sustainable landscapes, as well as climate resilience adaptation options, generally fails to include the full economic value of creating sustainable eco-systems. The AILEG team met with MADS and other stakeholders to 1) assess the current status of Colombia's resource valuations and PES and 2) determine what capacity building, methodological, and modeling support might be needed.

1. Status/Needs

Colombia is one of the few biologically mega-diverse[4] countries in the world. Its rich and unique ecosystems provide a range of services that underpin social and economic activities, including regulation of the hydrological cycle, erosion control, and protection against extreme weather events, among many others. However, these ecosystems and the services they provide have been eroded. They face a number of threats, including the expansion of agricultural activities, cattle grazing, mining, and planting of illegal crops. As the National Development Plan 2010–2014 acknowledges, the lack of economic valuation, information gaps, cumbersome regulations, and the absence of economic incentives have resulted in a lack of environmentally sound economic alternatives for local communities. In response to this challenge, the plan proposes the development and implementation of instruments to identify and set a value for ecosystem services and their linkages with human wellbeing. Under the current administration, MADS' goals include the completion of economic valuation studies for three priority ecosystems: wetlands, mangroves, and paramos.[5] These studies will support public policies and other decisionmaking processes, such as the determination of amounts to be paid under PES schemes or discussions on resource allocation for national park management. The valuation studies will focus on one specific site for each priority ecosystem, which MADS is in the process of identifying. While valuation efforts have been carried out in the past, they have been constrained by the lack of primary data, relying instead on data extrapolated from other countries, whose characteristics do not necessarily resemble Colombia's. The ministry has indicated that the absence of primary data is among the most severe challenges faced in efforts to complete the valuation studies.

MADS is also preparing a decree to define a formal framework for the PES schemes. Under the decree, landowners who manage their land in a way that ensures the provision of a well-defined environmental service will be able to receive economic compensation from those who benefit from such a service. According to the ministry, the PES schemes will consist of voluntary transactions between private or public entities. The decree will provide guidance on issues ranging from payment vehicles to selection of priority areas to be included in PES schemes and monitoring methodologies. Once the decree is

[4] "Biologically megadiverse" countries are a group of countries that harbor the majority of the Earth's species and are therefore considered extremely biodiverse. Conservation International identified 17 megadiverse countries in 1998. All are located in, or partially in, the tropics.

[5] Specifically located in the northern Andes of South America and adjacent southern Central America, the páramo is the ecosystem of the regions above the continuous forest line, yet below the permanent snowline. It is a neotropical high mountain biome with a vegetation composed mainly of giant rosette plants, shrubs, and grasses.

published, a major challenge will be building the capacity of the country's 32 CARs [Corporaciones Autonomas Regionales/Autonomous Regional Corporations] to implement it.

CARs are decentralized entities that roughly correspond to Colombia's sub-national administrative units (departments). They have an autonomous governance structure based on a steering committee that includes appointed representatives from both national and regional governments. Colombia's CARs have the dual function of implementing environmental policy (as determined by MADS) and managing the natural resources of a defined geographic region that usually corresponds to a department or an aggregation of municipalities with shared ecological and geographic characteristics. Human and financial resources vary significantly across CARs, but few of them have practical experience with PES. A different challenge relates to the need to establish a registry of PES mechanisms, which would help ensure that such mechanisms are consistent with the environmental and planning instruments in place, and that they target priority ecosystems. The ministry is currently assessing whether registration in the country's official registry would be a necessary condition to be able to obtain public funds for a PES scheme.

2. Recommended Technical Assistance

The AILEG team will support the development of economic valuation studies for priority ecosystems in Colombia. Given the dearth of and need for primary data, the AILEG team will discuss opportunities to support primary data collection in one of the priority sites (to be determined by MADS), together with economic analysis, to carry out the valuation. To build the capacity of the environmental authorities responsible for implementing PES schemes, the AILEG team will facilitate knowledge exchanges with Mexico or another country with relevant experience in PES schemes to discuss lessons learned and best practices. The knowledge exchange will target individuals who can then become trainers within Colombia. In addition, the AILEG team will support the development of an online registry of PES schemes, as required by MADS. The AILEG team will train different stakeholders on the use, operation, and maintenance of the registry.

Status of Economic and Investment Assessment of Colombia LEDS Analyses

With national and international support, the Government of Colombia and its leading economists and institutions have begun a variety of economic and investment analyses for transitioning to a low-emission growth path. The AILEG team assessed the status of these initiatives and identified additional needs for methodological support or the introduction or development of analytical tools.

1. Status/Needs

The Government of Colombia is currently conducting economic studies to support the ECDBC. Both top-down and bottom-up models are being developed to aid in the process of making decisions about the implementation of low-carbon actions. The top-down modeling exercise is being conducted by the DNP, which has developed a preliminary CGE model. The CGE model aggregates all sectors of the economy, analyzes cross-sectoral effects, and provides results on the impact of climate change on each sector of the economy. The model was build based on the multi-sector, multi-region General Equilibrium Environmental Model developed by the Organization for Economic Co-operation and Development, which quantifies the effects of polices on CO_2 emissions. The CGE model uses the results of the IPCC A1B scenario,[6] covering 57 sectors of the economy. The 57 were aggregated into 15

[6] Future greenhouse gas emissions are the product of very complex dynamic systems, determined by driving forces such as demographic development, socio-economic development, and technological change. The Intergovernmental Panel on Climate Change developed a set of scenarios to represent the range of driving forces and emissions in the scenario literature so as to reflect current understanding and knowledge about underlying uncertainties. The A1 storyline and

sectors, including agriculture, mining, energy, commerce, industry, transport, and services. The model predicts the effect of climate change on the economy, calculating percent increases or decreases in GDP from the business-as-usual (BAU) scenario for each sector and the whole economy. Initial results show that agriculture, livestock, fisheries, and silviculture[7] will be the sectors most impacted from climate change.

MADS has commissioned the University of Los Andes to perform a detailed bottom-up sector analysis. The priority sectors being analyzed by the university are agriculture, transport, solid waste, mining, and energy. The study will be completed in July 2012; the results are expected to be coupled with the CGE model. However, the GOC has requested technical assistance from AILEG in economic modeling to couple these models. Specific tasks being carried out by the University of Los Andes include the development of the MAC curves for the above sectors, based on mitigation actions from current country commitments and future plans for these sectors. The study will analyze trends in these sectors, looking at energy and fuel consumption; national and international sales of goods; methods for electricity pricing for the commercial, residential and public sectors; and growth projections from each sector. The study will also develop BAU projections for each sector and for the national aggregate of the sectors, and will look at CO_2 reductions from current commitments and planned mitigation actions. MADS will use these results to set initial mitigation action plans within the ECDBC. The ministry is also planning to perform additional comprehensive studies on priority sectors for mitigation based on the initial results from the University of Los Andes study.

2. Recommended Technical Assistance

The AILEG team proposes to provide technical assistance for coupling the CGE model with the sector model, once the sector modeling is finalized by the University of Los Andes.

In addition to the AILEG support services proposed by USAID for exploration, Abt Associates identified a number of other areas for possible technical assistance, based on interviews with government representatives, leading economists, and climate change experts in the country. Abt suggests that USAID consider supporting the following set of activities.

Agricultural Partial Equilibrium Model

Throughout the AILEG assessment team's trip to Colombia, the need for an agricultural sector model kept arising. Several stakeholders indicated that no agricultural partial equilibrium model that takes into account climate change has been developed or applied for Colombia. Because agriculture is a key sector of the economy, such a model is needed.

scenario family describes a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies. Major underlying themes are convergence among regions, capacity building, and increased cultural and social interactions, with a substantial reduction in regional differences in per capita income. The A1 scenario family develops into three groups that describe alternative directions of technological change in the energy system. The three A1 groups are distinguished by their technological emphasis: fossil intensive (A1FI), non-fossil energy sources (A1T), or a balance across all sources (A1B).

[7] The growing and cultivation of trees.

1. Status/Needs

The impacts of climate change on agriculture have generally been assessed using either partial equilibrium or general equilibrium approaches .[8] Because climate change may affect various sectors of the economy directly or indirectly, interactions between different sectors must be studied to assess the impacts of climate change on agriculture. CGE models are well-suited to depict interactions between agriculture and other sectors in the economy. However, treating agricultural policies in the CGE model framework poses a technical challenge—introducing allocation of lands for different uses. One approach is to develop an integrated assessment model, which couples a CGE model with a partial equilibrium agricultural land-use model. Although Colombia is working on its CGE model, it does not yet have a bottom-up sectoral model that links in agriculture.

2. Recommended Technical Assistance

The AILEG team proposes to provide assistance to develop and apply a partial equilibrium model to assess the impacts of climate change on agriculture (and thus the impacts on the economy as a whole).

LEDS Options in the Upper Magdalena River Basin Linked to REDD+ and Promoting Ecosystem-Based Adaptation by Developing Two Analytical Models

1. Status/Needs

The Magdalena River is the principal river of Colombia, flowing northward about 1,528 kilometers (949 miles) through the western half of the country.The Magdalena River Basin covers 274,000 square kilometers—almost a fourth of the Colombian territory. Two-thirds of Colombians live in this region. The basin produces 86 percent of the country's gross domestic product (GDP), including 75 percent of the country's agricultural GDP and 70 percent of its hydropower energy. Only 13 percent of the basin's forest cover is intact. In combination with unusually high rainfall during recent El Niño events, this has led to severe floods that have reduced national GDP by as much as 2 percent. Consequently, the government is seeking to improve land use and watershed management in order to avoid, mitigate, and adapt to future climatic events while also promoting sustainable economic growth. The upper Magdalena River Basin region currently represents a gap in USAID's REDD+ portfolio (as perceived by USAID and Colombian counterparts), which includes the Bio-REDD program focused on projects on the Pacific Coast and Caribbean Plain, the Initiative for the Andes and Amazon, and the Department of State's investments in the lowland forests of the Amazon and Orinoco basins. The Andes region in Colombia is almost identical to the Magdalena River

[8] A *partial equilibrium model* depicts part of an overall economy, assuming that industries have no effects on each other or the rest of the economy. A *general equilibrium model* looks at the economy as a complete, interdependent system, providing an economy-wide analysis that captures links between agriculture and non-agricultural sectors.

Basin region, which currently receives no support from USAID in spite of its overriding importance to the Colombian economy.

The GOC's Reducing Emissions from Deforestation and Forest Degradation (REDD+) program organizes its initiatives into five regions: the Pacific Coast, the Caribbean Coast, the Amazon Lowlands, the Orinoco Plains, and the Andes. The Andes is considered to be at particular risk from climate instability due to the highly impacted nature of its mountain ecosystems and the relative low forest cover (13 percent), most of which is cloud forest[9] under threat from expanding small farmer systems.

In response to widespread flooding in the Magdalena River Basin during the 2010 El Niño event, the GOC established an adaptation fund and a reconstruction fund (more than $1 billion) to invest in adaptation measures to combat the impact of flooding caused by extreme weather events. There is concern in USAID, the Ministry of the Environment, and Colombia's Magdalena river regional autonomous corporation (CorMagdalena) that national, regional, and local institutions are not recognizing the best use of resources due to an over-emphasis on infrastructure and an under-appreciation of the cost-effectiveness of ecosystem-based adaptation, particularly the linkages between land use and water, hydropower, irrigation, and drinking water.

The Nature Conservancy is implementing a project funded by the Global Environmental Facility ($7 million) that focuses on the Magdalena River Basin. This initiative has evaluated biodiversity for the entire basin using its well-known approach to eco-regional mapping and freshwater biodiversity. Its interventions, however, will focus on impacts, conservation of wetlands, and land-use planning in the downstream portion of the basin, rather than on forest conservation in the upper watershed (and related climate change issues), which is deemed a priority.

The Department of Huila is situated at the extreme southern tip of the Magdalena River Basin. It constitutes a naturally confined watershed that originates in the Macizo Colombiano and drains northward between the Oriental and Central Cordilleras. It is not a tributary to the Magdalena River, but the headwaters of the main stem of the Magdalena River. CAM [the Corporación Autónoma Regional del Alto Magdalena/Regional Autonomous Corporation of the Upper Magdalena] is seeking assistance to implement LEDS and REDD+ initiatives. CAM is essentially the regulatory entity for the natural resources of the Department of Huila; it is one of 32 CARs. Two identified needs are 1) to improve knowledge related to watershed management in the upper Magdalena watershed and 2) to improve knowledge and provide information related to land-use planning to the CAM and its constituent municipalities. USAID's Forest, Carbon, Markets and Climate (FCMC) project will work with CAM and other stakeholders to address these and other needs related to advancing LEDS. FCMC has requested AILEG support to help develop and build capacity in the use of two economic environmental/climate change models.

2. Recommended Technical Assistance

Working in coordination with USAID/Colombia and EGAT, the AILEG team proposes to develop and apply two models: 1) a land-use/hydrology/energy generation-PES model and 2) a land-use/partial equilibrium model. The team would develop and apply the first of these models to demonstrate the economic value of REDD+ and land use-based LEDS options by prolonging the economic lifespan of hydropower facilities. This could be based on the FOR-POWER modeling framework[10] developed by

[9] A cloud forest, also called a fog forest, is a generally tropical or subtropical evergreen montane moist forest characterized by a persistent, frequent or seasonal low-level cloud cover, usually at the canopy level.

[10] The modeling framework 'FOR-POWER' simulates contrasting levels of power generation in order to calculate the impact of a truncated lifespan on hydropower revenues. Calculated values are then used to establish a baseline for a PES

Conservation International for Cambodia in collaboration with Department of Civil Engineering at the University of Canterbury (New Zealand). The AILEG team would apply the model to the upper Magdalena River Basin in Huila and would also integrate the various FOR-POWER model components into a web-based tool that could be used by other CARs and in other regions. The team would also develop and apply partial equilibrium models that compare different land-use options and productive models—such as the International Model for Policy Analysis of Agricultural Commodities and Tradeeveloped by the International Food Policy Research Institute—with respect to their economic feasibility and market competitiveness.

MAC Curve Template Development and Dissemination

As discussed above, Colombia is developing MAC curves for a number of sectors. While meeting with LEDS stakeholders, one issue raised was the need for the various sectoral curves to be developed and applied consistently. The AILEG team was asked by staff at MADS whether the project could assist with capacity building in this area. Because the AILEG team received a direct request from MADS to consider this, we explore the option below. However, at this time we believe the needed assistance could be provided by other contractors and donors.

1. Status/Needs

MADS has contracted with the University of Los Andes to develop MAC curves for a number of sectors. The level of experience of different departments at the university may vary, however, as will the quantity and quality of input data by sector. However, since the university has been contracted for the development of all the curves (other than commercial building), it is likely that they will be created and applied in a consistent manner. Furthermore, the AILEG team understands that the Mitigation Action Plans & Scenarios (MAPS) program will be supporting a workshop in the near future to address modeling issues.

2. Recommended Technical Assistance

Because the University of Los Andes has been contracted to undertake the development of MAC curves in most sectors, and given the anticipated capacity building to be supported by MAPS, the AILEG team proposes that any additional intervention regarding consistency in MAC curve template development or capacity building wait until a further need is identified or requests for such assistance are received. This does not preclude assistance in the development of a commercial building sector MAC curve, as described earlier in this report.

scheme that would pay for forest conservation in the upstream part of the watershed that supplies water to the hydropower facility.

Proposed Technical Assistance Timeline

Table 2 illustrates the timeline for the proposed technical assistance activities to support the AILEG Colombia Needs Assessment.

Table 2: Proposed Activities and Timeline for AILEG Colombia Assistance

	2012									
Activity	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1. Finalize work plan and budget										
2. Develop MAC curves for the institutional and commercial building sectors										
3. Provide economic valuation support for one priority ecosystem										
4. Carry out a study tour to Mexico (PES)										
5. Support development of a registry system for PES										
6. Develop and apply a land-use/hydrology/ energy generation PES model and a land-use/partial equilibrium model in the upper Magdalena River Basin										
7. Provide technical assistance to develop and apply a partial equilibrium model for the agricultural sector										
8. Provide technical assistance for coupling bottom-up and top-down economic models										

Next Steps

The proposed next steps for undertaking AILEG assistance in Colombia include the following:

1. Obtain feedback from EGAT and USAID/Colombia on proposed activities
2. Confirm with Colombian counterparts and stakeholders that these interventions will be useful in implementing LEDS and ensuring country commitment
3. Analyze the needs related to each intervention in greater depth
4. Develop a detailed work plan with proposed technical teams and LOE
5. Develop a budget to accompany the work plan
6. Obtain final USAID approval

ANNEX—Meetings and Contacts

Date	Institution	Participants Contact Information
January 30, 2012	USAID/Colombia	Christopher Abrams, Environment Team Leader, cabrams@usaid.gov James Lee, Environmental Climate Change Advisor, jalee@usaid.gov Francisco Gonzales, PhD., Director, Economic Unit, fgonzales@usaid.com
January 30, 2012	University of Los Andes	Angela Cadena, Engineering Department, acadena@uniandes.edu.com
January 30, 2012	DNP [Departamento Nacional de Planeación/ National Planning Department]	Ana Maria Loboguerrero, Economic Modeler, aloboguerrero@dnp.gov.co Carolina Urrutia, Sub-Director, Environmental Sustainable Development, currutia@dnp.gov.co
January 31, 2012	MADS [Ministerio de Ambiente y Desarrollo Sostenible/Ministry of Environment and Sustainable Development]	Andrea Garcia, Climate Change Director, agarcia@minambiente.gov.co Maria Paula Mendieta, Economic Advisor, mariapmendieta@gmail.com Christopher Abrams, Environment Team Leader, cabrams@usaid.gov James Lee, Environmental Climate Change Advisor, jalee@usaid.gov
February 1, 2012	IPSE [Instituto de Planificación y Promoción de Soluciones Energeticas para las Zonas No Interconectadas/ Institute of Planning and Promotion of Energy Solutions in the Non-Interconnected Zones]	Adrian Campos, Project Coordinator Evelyn Schottlaender, Coordinator of International Cooperation, Evelyn_shottlaender@hotmail.com Christopher Abrams, Environment Team Leader, cabrams@usaid.gov James Lee, Environmental Climate Change Advisor, jalee@usaid.gov
February 1, 2012	USAID Climate Change Consultants	Carlos Tawil, Coordinator Oscar Urbina, Trade John Arias, Agriculture Claudia, Transport Adriana, Treasury Fanny Gomez, Energy
February 2, 2012	Fedesarrollo	Marcela Pombo, General Secretary, Sgeneral@fedesarrollo.org.co Helena García Romero, Researcher, Hgarcia@fedesarrollo.org.com

February 2, 2012	USAID/National Renewable Energy Laboratory/U.S. Department of Agriculuture Forest Service Training Reception	Christopher Abrams, Environment Team Leader, cabrams@usaid.gov James Lee, Environmental Climate Change Advisor, jalee@usaid.gov Dana Moore, Climate Change Program Specialist, danammoore@fs.fed.us Tim Killeen, Conservation International Marcela García López, MADS, magarcia@minambiente.gov.co
February 3, 2012	MADS	Xiomara Sanclemente, Director of Forests, Biodiversity, and Ecosystem Services, xsanclemente@minambiente.gov.co Marcela García López, magarcia@minambiente.gov.co
February 6, 2012	Consejo de Construcción Sostenible/Green Building Council	Cristina Gamboa, CEO, cgamboa@cccs.org.co María del Pilar Medina, Technical Director, Pmedina@cccs.org.co Angela Cadena, University of Los Andes, acadena@uniandes.edu.com Hernando Vargas Caicedo, University of Los Andes, hvargas@uniandes.edu.co Maria Paula Mendieta, Economic Advisor, mariapmendieta@gmail.com